DACA42-03-C-0024

LOGANEnergy

Midterm Report
PEM Fuel Cell Demonstration, US Naval Air Depot, Cherry Point, North Carolina

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY02

Headquarters:

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Suite 100-175
Roswell, GA 30076
Ph (770) 650-6388

US Naval Air Depot, Building 154AE
MCAS Cherry Point, NC

July 13, 2005

California:

74837 Diamond Bar Rd
29 Palms, CA 92277
Ph (760) 367-5005

Executive Summary

LOGANEnergy has installed one Plug Power GenSys5P 5kW PEM fuel cell power plant at Building 154AE belonging to the Naval Air Depot at MCAS Cherry Point, NC. The unit is fueled by LPG and is installed to operate in both grid parallel and grid independent configurations. Local subcontractors were hired to assist with the electrical, mechanical, and thermal recovery installation tasks.

It is anticipated that the host site will experience a net annual energy cost increase of approximately $2,216 over the cost of displaced utility power. This is due to the relatively low operating efficiency of the Plug propane unit (20%), and the comparative high cost of LPG. The host site project engineer is Bill Livingston, and may be reached at (252) 464-8855 or livingstonwh@navair.navy.mil.

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

US Naval Air Depot Building 154AE PEM Demonstration Project, MCAS, Cherry Point, NC

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcombe Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCore 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Brian Davenport is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex11939, and his email address is brian_davenport@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	724.449.4668
Fax	770.650.7317	770.650.7317
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5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	724.449.4668
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: Four Year PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability. LOGAN performs the quarterly and annual service prescribed by the UTC, and performs other maintenance as required. The periods of unavailability are chiefly due to persistent inverter problems that seem to be endemic to the Toshiba power conditioning balance of the system. Field modifications and operating adjustments have largely cured the problem. Quarterly service events take 10 hours to complete with the unit under load, and the annual event takes approximately 35 hours with the unit shut down.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys5C and one 5kWe GenSys5P PEM power plant installed at NAS Patuxent River, MD.
Contract # Plug Power 100303, 01/2004 to 12/2004

Plug Power
Mr. Brian Davenport
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1939

LOGAN performed the start-up of both units after Southern Maryland Electric Cooperative completed most of the installation work. The units are located at residential sites at Patuxant River Naval Air Station, VA and operate in standard gird connected/grid independent configurations. Both operate at 4.5kWe and have maintained 98% availability. The units, S/Ns 241 and 242 are two of the very latest GenSys models to reach the field. S/N 242 is Plug Power's first LPG fueled system to go into the field. Both have set a new level of performance expectations for this product, and are indicative of the success of the various test and evaluation programs that have been conducted over the past two years.

c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5 year service and maintenance agreement. Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partners LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

On April 20, 2004 LOGAN completed the installation of a 600kWe PC25C CHP fuel cell installation in Fresno, CA. The system operating configurations allow for both grid parallel and grid independent energy service. The grid independent system is integrated with a multi unit load sharing electronics package and static switch, which initial development was funded by ERDC CERL in 1999. This is the third fuel cell installation that uses the MULS System. The thermal recovery package installed in the project includes a 100-ton chiller that captures 210 degree F thermal energy supplied by the three fuel cells to cool the first three floors of the host facility. The fuel cells also provide low-grade waste heat at 140 degrees F that furnishes thermal energy to 98 water source heat pumps located throughout the 12-story building during the winter months.

7.0 Host Facility Information

The Naval Aviation Depot (NADEP) is located at MCAS Cherry Point, NC, and provides extensive maintenance and engineering support to Navy and Marine Corps aviation, as well as other armed services, federal agencies and foreign governments.

The Marine Corps Air Station at Cherry Point itself now includes 13,164 acres on the air station proper with an additional 15,975 acres of auxiliary activities, including Marine Corps Auxiliary Landing Field Bogue, along Bogue Sound in Carteret County. The largest command at Cherry Point is the 2nd Marine Aircraft Wing. The 2nd MAW headquarters is located at Cherry Point, as well as the Marine Aircraft Group 14, Marine Wing Support Group 27, and Marine Air Control Group 28. Other 2nd MAW units include helicopter squadrons at MCAS New River, N.C., and F/A-18 Hornet squadrons at MCAS Beaufort, S.C. Marine Aircraft Group 14's flying squadrons include three AV-8B Harrier squadrons, four EA-6B Prowler squadrons and one KC-130 Hercules refueling squadron. The Marine Corps' only Harrier training squadron and only Hercules training squadron are also located at the Cherry Point air station.

Brigadier General Patton is currently assigned as the Commander, Marine Corps Air Bases Eastern Area and Commanding General, Marine Corps Air Station Cherry Point. Brigadier General Patton entered the Marine Corps through the PLC program in 1976 following graduation from Southwest Missouri State. He began his military career with enlistment in the Army in 1968 and was selected for the Warrant Officer Helicopter Program in 1969. Receiving Army aviator wings in 1970, he served 13 months combat duty in Southeast Asia. Brigadier General Patton has accumulated 5,600 hours of mishap free flying in over 30 different aircraft. His personal decorations include the Legion of Merit, Distinguished Flying Cross, Bronze Star Medal and 51 Air Medals, one with a Combat V.

The Naval Air Depot Cherry Point is one of three U.S. Navy depots under the Naval Air Systems Command, headquartered in Patuxent River, Maryland. The other two depots are located in Jacksonville, Florida, and North Island, California. NADEP Cherry Point is the only one of the three facilities to be under the command of Marine Corps officers. From its beginnings in 1943 as the Overhaul and Repair Department aboard Marine Corps Air Station Cherry Point, the Naval Air Depot has grown to become eastern North Carolina's largest industrial employer and a true national asset. The depot employs civilian, military and contractor personnel, who work in a wide variety of skilled technical and professional positions. The depot sits on nearly 150 acres on board Marine Corps Air Station Cherry Point, North Carolina. The depot's facilities are spread over more than 100 buildings and structures.

For nearly 60 years, NADEP Cherry Point has never lost focus of its central mission -- "Service to the Fleet." The depot is dedicated to providing our nation with the highest quality of depot-level maintenance, engineering and logistics support for DoD aviation. In addition to a high-quality product, the depot ensures this support is delivered on time and at the least cost. By working smarter, improving processes, focusing on quality and enlisting the support and involvement of the entire work force, the depot continues to be a model of quality and productivity improvement in the federal government. For all the employees at the Naval Air Depot, Cherry Point, North Carolina, "Service to the Fleet" is not just a motto; it's a commitment. The propane provider at Cherry Point MCAS is Jenkins Gas.

8.0 Fuel Cell Installation

Since October 2003, LOGAN has worked closely with NAVDEP and fuel cell project engineers Bob King and Bill Livingston to site a Plug Power 5kW fuel cell at one of its maintenance facilities. After considering several alternatives, NAVDEP chose Building 154AE to be the host site for the project. All of the installation tasks required to commission the unit were discussed during extensive briefings with NAVDEP over several weeks in November 2003 and January 2004. Additionally, LOGAN personnel performed two site visits prior to scheduling the kick-off meeting to insure that all major installation issues were covered. However, at the meeting, LOGAN learned for the first time that siting a 500-gallon LPG storage tank at Building 154AE would

require special security considerations. A representative from base security stated that the 500-gallon LPG tank proposed for the project would have to sit within a security fence enclosing a 25-foot open radius around the tank. This revelation led to an extensive site reevaluation to determine both how and where to install the fuel cell and LPG tank at the maintenance facility.

Figure 1 – LPG Tanks and Security Fence

In order to keep to the original plan while meeting the new security constraints, it was determined that the LPG tank would need to be downsized to two separate 125 gallon tanks. This decreased supply mitigated the requirements for an enlarged security area required for the 500 gallon tank that was preferred for the project. However, this solution will impose an additional logistical burden for the host because the tanks will need filling at more frequent intervals to insure that it is maintained at a minimum safe fill level and pressure level.

The fuel cell is connected to the facility in a grid parallel/grid independent configuration, feeding a 60-amp breaker in the existing main service panel and three 15-amp circuit breakers in the emergency panel that were added by LOGAN. The emergency disconnect switch and accompanying electric meter are shown in Figure 2 below. Overall, the installation process took 436.5 hours to complete, and was finished on December 16, 2004.

Figure 2 – Emergency Disconnect and Watt-Meter

The unit operates normally at 2.5 kW, consuming approximately 12 gallons of LPG per day. A 20,000 Btu fan coil unit that provides space heating on the shop floor during the winter months captures fuel cell waste heat. A photo of the unit appears below in the thermal recovery section. A simple one-line drawing of the installation appears below in Figure 3.

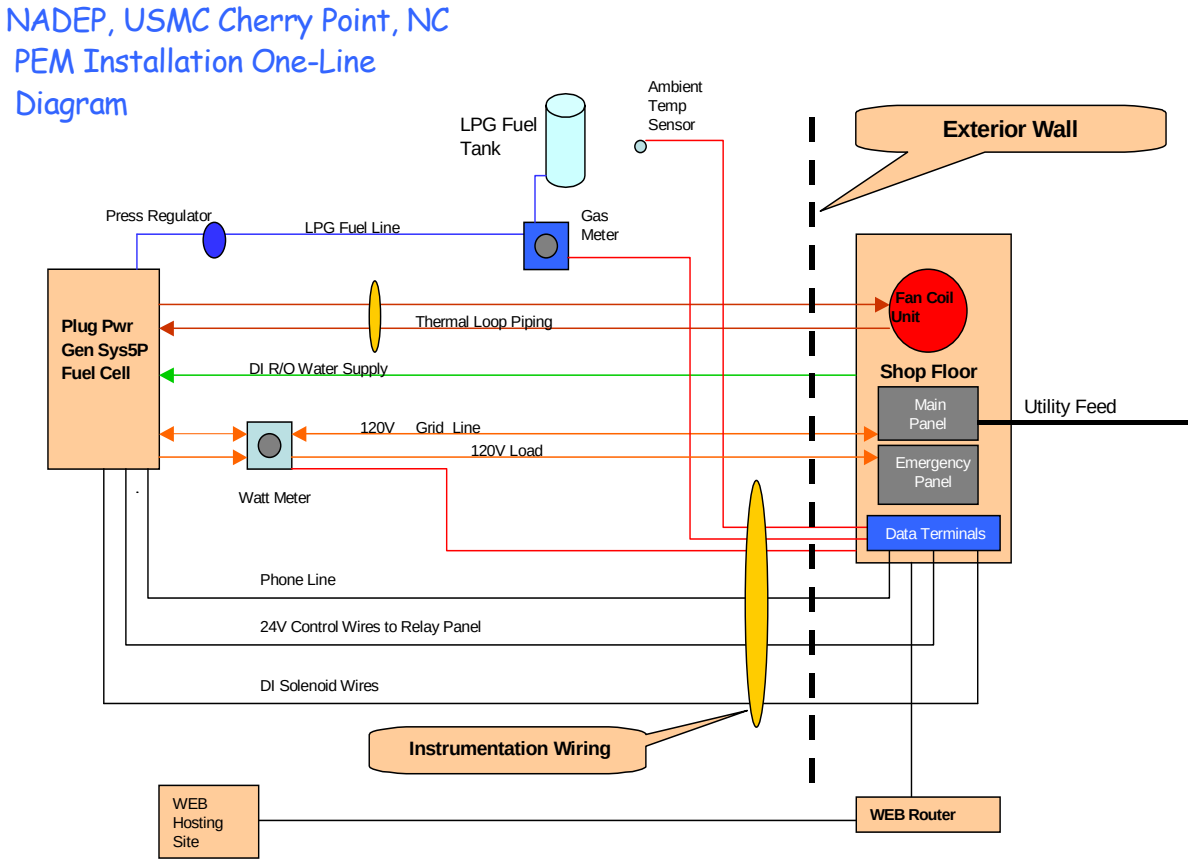

Figure 3 – Installation Line Diagram

Figure 3 above, presents a one-line diagram of the Cherry Point fuel cell installation. The diagram illustrates utility, emergency power supply, and control interfaces including, gas, power, water and instrumentation devices installed at Building 154AE.

The electrical conduit runs between the facility load panels and the fuel cell are approximately 15 feet. The Reverse Osmosis/DI water tubing run that provides filtered process water to the power plant is also approximately 15 feet in distance between the filtration unit and the fuel cell.

9.0 Electrical System

The Plug Power 5kW GenSys5P has a maximum output of 4.5 kW at 120 volts AC, 60 Hz. Under normal operating conditions the unit will provide 2.5 kW service to the maintenance facility's main service panel seen at right in Figure 4.

In addition LOGAN has installed an emergency service panel to the left of this main panel and transferred up to 30 amps of load to simulate critical circuit support during the demonstration period. A two-pole wattmeter monitors both the grid parallel and grid independent conductors to record fuel cell power distribution to both the existing panel and the new critical load panel.

Even so, the emergency load panel has been wired to the grid independent bus in the fuel cell so as to provide power to the panel in the event of a utility failure. The service panel is located on the east wall of the maintenance facility, approximately 200 feet from the fuel cell.

Figure 4 – Main Service Panel

The fuel cell inverter controller monitors the grid while operating in a normal grid parallel/synchronous configuration providing base load power. When the controller detects a loss of grid signal, it electrically disconnects from the utility grid at the 60 amp circuit breaker described above, and reconfigures to the grid independent operating mode in order to follow only the discrete load requirements on the critical load panel. While the grid is unavailable, the fuel cell will provide up to 45 amps of power to the critical panel. Once the grid returns to duty, the fuel cell inverter will revert to the base load configuration again. Since the change back and forth between the two operating configurations requires 2 seconds, the existing UPS batteries carry the server loads during that short interval.

10.0 Thermal Recovery System

The GenSys5P delivers approximately 20,000Btu/h to the customer heat exchanger at the 2.5kW power set-point, which will be maintained during the course of the test period. In order to demonstrate this capability, LOGAN has installed a Modine HD47L fan coil unit in the maintenance building in order to supplement the existing heating system in use at the facility. A picture of the Modine 22,000 Btu fan coil unit can be seen below and to the right in Figure 6. The unit has been suspended from the maintenance building's ceiling, also seen below in Figure 5, on the left. The unit has been plumbed into the fuel cell's heat exchanger that supplies 20,000 Btu/h at 60 degrees C, with a flow rate of 2.5 GPM. The Hydronic Heater, pictured below, provides a warm air output of 35 degrees C at 860 cfm.

Figure 5 – Hydronic Heater Installed

Figure 6 – Modine HC 47L Heater

11.0 Data Acquisition System

Over the last two years, in the course of developing numerous small-scale PEM fuel cell sites, LOGAN is learning to appreciate the importance of Web based real-time communications to manage distributed resources. With growing numbers of fuel cell units operating at diverse locations across the US, this capability introduces a cost effective means of supporting the fleet and capturing data that is necessary to manage systems and evaluate performance. While individual system installations are still very costly, they do provide a more cost effective means of managing distributed generation resources. As an example, the primary field engineer for this project has to travel approximately 4 hours to reach the fuel cell site. Typically these trips are necessary to service and maintain the fuel cell installation or to download performance data. With the advent of real-time communications, streaming data is continuously stored at a central hub, and it is constantly available for retrieval and analysis. The communications package also provides the operator with functional screens that display system status and performance, operational trending, system alarming and service callouts. Having access to this information refines the troubleshooting process when malfunctions occur, and permits the distributed generation operator to support more units over a wider area with fewer service personnel than would otherwise be possible. In many cases today, complete troubleshooting of a system alarm, turndown or shutdown may be performed from a computer terminal. With the next generation system, it will be possible to make remote corrective inputs to the system to reduce shutdown incidents or at least dispatch service confidently with the parts necessary to quickly turn the unit around.

At this point on the system learning curve, LOGAN has recognized that system dependability is more difficult to achieve than a simple “plug and play” device. For example, the quality and reliability of individual sensors and instrumentation that create and send output signals to terminals at the web router interface are critical to optimum performance. Invariably, these components require signal strength adjustment at the terminal block to insure that their discrete inputs are readable by the CEC system. Discovering the proper voltage range required for each signal loop is most often achieved by trial and error, requiring multiple site visits to establish a readable connection. In other instances, LOGAN has discovered that flow metering devices and thermal couples often require high levels of maintenance and/or replacement to support continuous data collection. Heretofore, LOGAN has purchased comparatively inexpensive components to meet these requirements, but has learned the value of installing robust and durable commercial grade components that cost more to install but provide trouble free service.

Pictured below, in Figure 7, is a schematic drawing of the RTU (Remote Terminal Unit) Web communications package architecture installed at this site. Below that, in Figure 8, is an example of one of many online data screens maintained by the Connected Energy control center. This particular screen provides the operator with a quick indication of system status.

To view the operation of this unit, log on to https://www.enerview.com/EnerView/login.asp Then login as: Logan. User and enter Password: guest. Select the box labeled Cherry Point MCAS, or navigate other LOGAN sites using the tool bars or html keys.

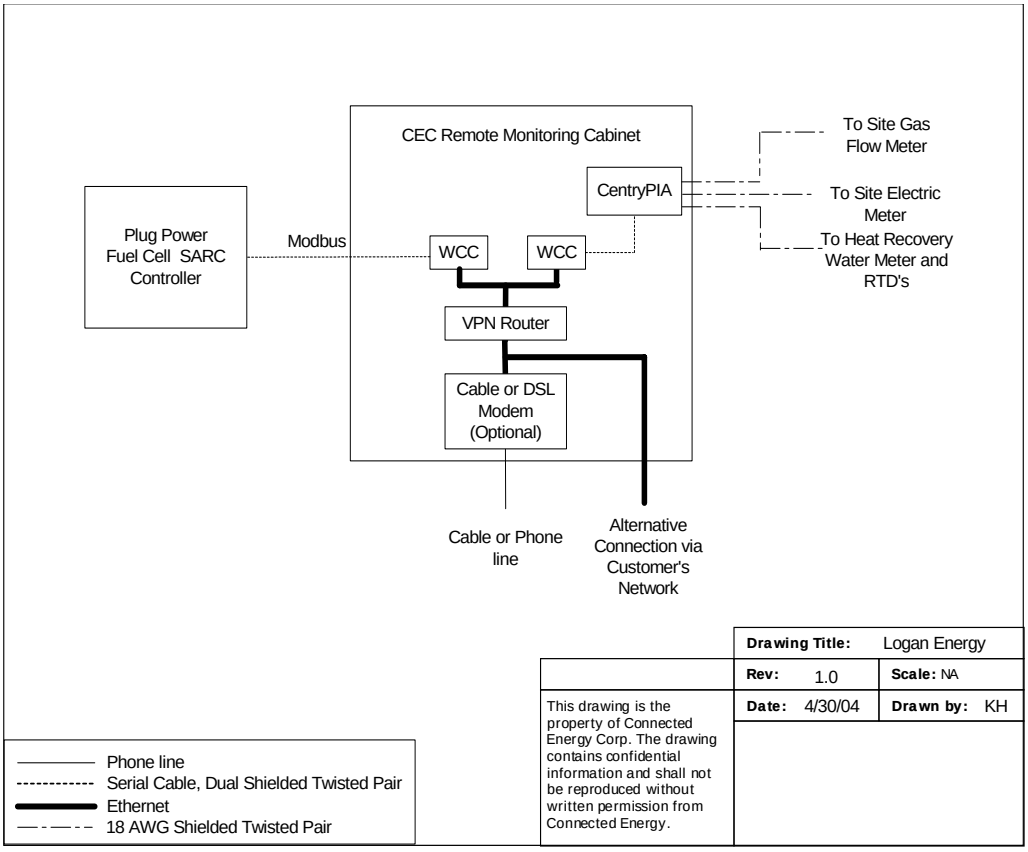

Figure 7 – RTU Connected Energy Architecture

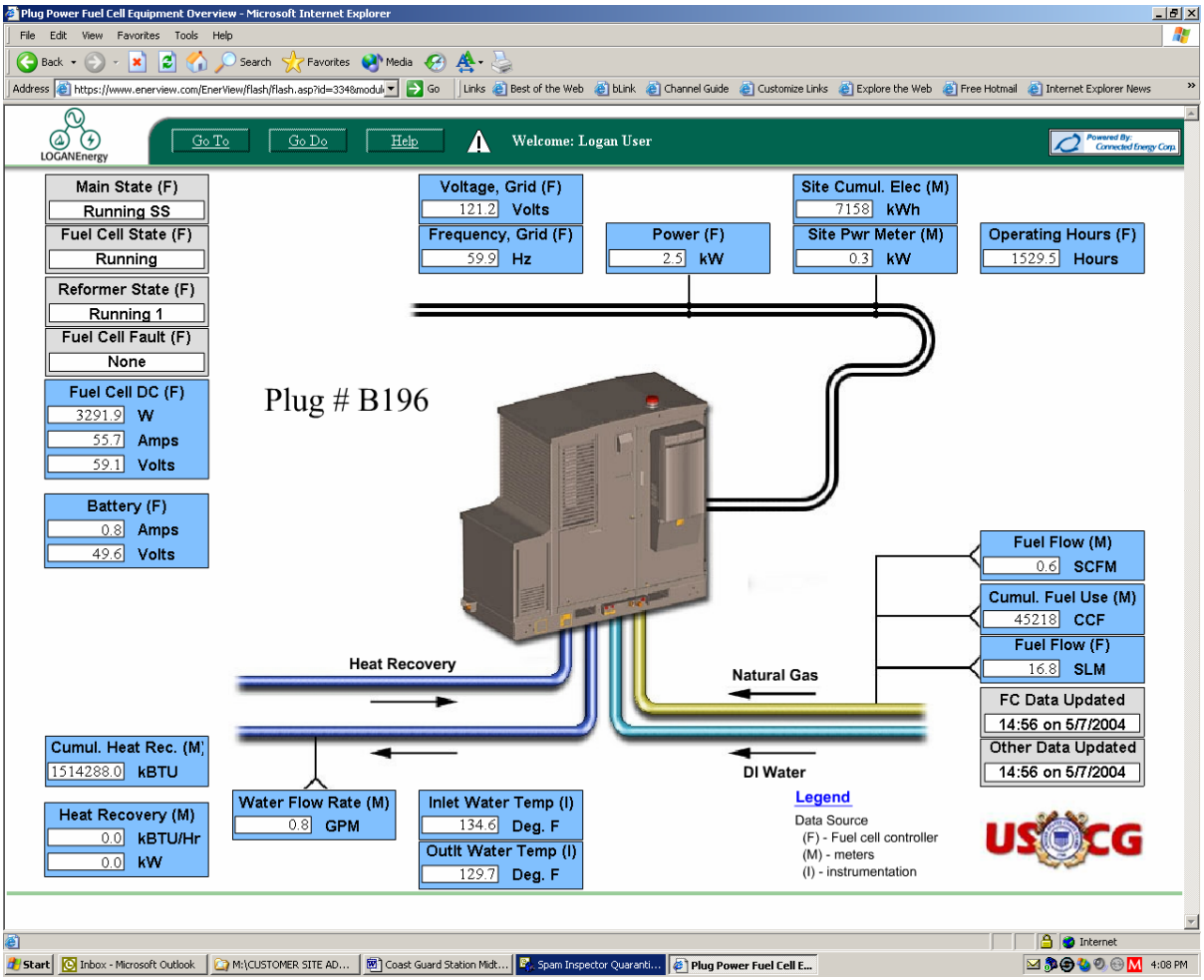

Figure 8 – Connected Energy Online Data Screen

12.0 Fuel Supply System

The fuel supply to the Cherry Point PEM unit begins at two separate 125 gallon LP Gas storage tanks located about 25 feet from the fuel cell pad. The original plans called for a 500 gallon LPG tank, however, security considerations called for a downsizing of the supply volume. The tanks are situated within a security fence on the same side of Building 154AE as the fuel cell pad. Before entering the fuel cell inlet, the gas passes through a flow meter, which sends a flow signal to a terminal in the Web package RTU to capture and store the data. Then, a pressure regulator reduces the line pressure to 14 IWC before entering the “gas box” section of the reformer. HD-5 LPG is the propane variant required by the manufacturer for this product because it is rated with the highest percent propane content from among the several categories of LPG. While operating at a set-point of 2.5 kW, the Plug unit consumes about 0.53 gallons of liquid propane gas per hour. This rate of consumption calls for the tanks to be refilled about once every two weeks.

13.0 Installation Costs

Cherry Point MCAS PEM Demonstration Project

Project Utility Rates	
1) Water (per 1,000 gallons)	$2.10
2) Utility (per KWH)	$0.0600
3) LP GAs (per Gal)	$1.01

First Cost	**Estimated**	**Actual**
Plug Power 5 kW GenSys5P	$ 75,000	$ 75,000
Shipping	$ 2,800	$ 1,516
Installation Electrical	$ 2,275	$ 9,695
Installation mechanical & Thermal	$ 2,250	$ 5,506
Watt Meter, Instrumentation, Web Package	$ 9,650	$ 10,570
Site Prep, labor materials	$ 925	$ 1,005
Technical Supervision/Start-up	$ 4,500	$ 4,750
Total	**$ 97,400**	**$ 108,042**
Assume Five Year Simple Payback	$ 19,480	$ 21,608

Forcast Operating Expenses	Volume	$/Hr	$/ Yr	
LPGas GPH @ 2.5kW	0.53	$ 0.54	$ 4,220.31	
Water Gallons per Year	14,016		$ 29.43	
Total Annual Operating Cost				$ 4,249.74

Economic Summary			
Forcast Annual kWH		19710	
Annual Cost of Operating Power Plant	$	0.216	kWH
Est. Credit Thermal Recovery Rate on kW(t)		($0.043)	kWH
Project Net Operating Cost	$	0.172	kWH
Displaced Utility cost	$	0.060	kWH
Energy Savings (Cost)		($0.112)	kWH
Annual Energy Savings (Cost)		($2,216.04)	

Explanation of Calculations:

Actual First Cost Total is a *sum* of all the listed first cost components.
Assumed Five Year Simple Payback is the Estimated First Cost Total *divided by* 5 years.

Forecast Operating Expenses:

LP Gas usage in a fuel cell system set at 2.5 kW will consume 0.53 gph. The cost per hour is 0.53 gph *x* the cost of LPGas/gallon. The cost per year of $4220.31 equals the product of cost per hour ($0.54) *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.

LPGas fuel cell systems set at 2.5 kW output will consume 1.6 gallons of water per hour through the DI panel. The total volume of water consumed of 14,016 gallons per year is 1.6 gph *x* 8760 hours per year. The cost per year at $29.43 equals 14,016 gph *x* cost of water to the site of $2.10 per 1000 gallons.

The Total Annual Operating Cost, $4249.74 is the *sum of* the cost per year for LPGas and the cost per year for the water consumption.

Economic Summary:

The Forecast Annual kWh at 19,710 kWh is the product of 2.5 kW set point for the fuel cell system *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.
The Annual Cost of Operating the Power Plant at $0.216 per kWH is the Total Annual Operating Cost at $4249.74 *divided by* the forecast annual kWh at 19,710 kWh.
Credit Annual Thermal Recovery at -$0.043 equals 7800Btu/h *divided by* 3414Btu/kW. This is then *multiplied by* 0.9 availability *x* 0.35 estimated thermal load factor *x* the cost of electricity at $0.060 per kWh *x* (-1). As a credit to the cost summary, the value is expressed as a negative number.
The Project Net Operating Cost is the *sum* of the Annual Cost of Operating the Power Plant *plus* the Credit Annual Thermal Recovery.
The Displaced Utility Cost is the cost of electricity paid by Cherry Point MCAS to the local utility.

Energy Savings (Cost) equals the Displaced Utility Cost *minus* the Project Net Operating Cost expressed in kW.

Annual Energy Savings (Cost) equals the Energy Savings *x* the Forecast Annual kWh.

14.0 Acceptance Test

The 8-hour acceptance test concluded on December 16, 2004, following the first successful start-up of the system. The time allotted for each task in the report approximate the standards recommended by the manufacturer. Please see Appendix 2 for Installation and Start-up Test Report.

<u>Appendix</u>

1) Monthly Performance Data

Run Times and Efficiencies
December 2004 – May 2005

System Number:		**SU01B000000312-LPG**									
Site Name:		**Cherry Point**									
Commission Date:		**12/16/2004**									
Lower Heating Value:		**943**									
Month	**Run Time (Hours)**	**Time in Period (Hours)**	**Availability (%)**	**Energy Produced (kWe-hrs AC)**	**Output Setting (kW)**	**Average Output (kW)**	**Capacity Factor (%)**	**Fuel Usage, LHV (kWh)**	**Fuel Usage, LHV (BTUs)**	**Fuel Usage (SCF)**	**Electrical Efficiency (%)**
insert month	*insert operating hours*	*insert hours in month*	**1*	*insert produced energy*	*insert output setting*	**2*	**3*	*insert fuel consumption*			**4*
December, 2004	384	384	100%	956.2	2.5	2.49	49.80%	3740	1.28E+07	12614	25.59%
January, 2005	744	744	100%	1849.0	2.5	2.49	49.70%	7253	2.47E+07	24465	25.51%
February, 2005	672	672	100%	1686.0	2.5	2.51	50.18%	6790	2.32E+07	22903	24.85%
March, 2005	744	744	100%	1867.0	2.5	2.51	50.19%	7888	2.69E+07	26607	23.68%
April, 2005	720	720	100%	1809.0	2.5	2.51	50.25%	7480	2.55E+07	25231	24.20%
May, 2005	744	744	100%	1860.1	2.5	2.50	50.00%	7896	2.69E+07	26634	23.57%
			#DIV/0!		2.5	#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!		2.5	#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!		2.5	#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!		2.5	#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!		2.5	#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!		2.5	#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!			#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!			#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!
			#DIV/0!			#DIV/0!	#DIV/0!		0.00E+00	0	#DIV/0!

2) Documentation of Acceptance Test

Installation Acceptance Test Report

Site: Cherry Point MCAS, Building 154AE

Cherry Point, North Carolina

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed	JW	9/2/04	2
Stack Installed	JW	9/2/04	4
Stack Coolant Installed	JW	9/2/04	1
Air Purged from Stack Coolant	JW	9/2/04	0.5
Radiator Coolant Installed	JW	9/2/04	3
Air Purged from Radiator Coolant	JW	9/2/04	1
J3 Cable Installed	JW	9/16/04	1
J3 Cable Wiring Tested	JW	9/16/04	0.5
Inverter Power Cable Installed	JW	9/16/04	0.5
Inverter Power Polarity Correct	JW	9/16/04	0.5
RS 232 /Modem Cable Installed	JW	9/16/04	0.5
DI Solenoid Cable Installed with Diode	JW	9/2/04	0.2
LP Gas Pipe Installed	JW	7/04	8
DI Water / Heat Trace Installed	JW	9/2/04	2
Drain Tubing Installed	JW	9/2/04	1

Commissioning Check List and Acceptance Test

TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK	JW	12/16/04	4
SARC Name Correct	JW	12/16/04	1
Start-Up Initiated	JW	12/16/04	2
Coolant Leak Checked	JW	12/16/04	1
Flammable Gas Leak Checked	JW	12/16/04	5
Data Logging to Central Computer	JW	12/16/04	2
System Run for 8 Hours with No Failures	JW	12/16/04	8

3) Daily Work Logs
LOGANEnergy Field Technicians
November 2003 – January 2005

LOGANEnergy Corp.			
Monthly Site Report			
Period	November-03		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Harvell	11/12/03	312	Drove to New Bern.
	11/13/03		Met with Bill Livingston and others to discuss fuel cell siting and issues.

LOGANEnergy Corp.			
Monthly Site Report			
Period	February-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
M Harvell	2/17/04	312	Met with Bill Livingston and friends at the site they selected and discussed issues. It looked fine.

LOGANEnergy Corp.			
Monthly Site Report			
Period	July-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Worley	7/13/04	312	Tuesday - Drove from Augusta to Havelock.
Worley	7/14/04	312	Wednesday - Went to Cherry Point. Met with base contacts. Picked up necessary paperwork to get passes. Prepared pad for fuel cell. Got fuel cell set in place. Set electric meter/disconnect. Installed stack.
Worley	7/15/04	312	Thursday - Returned to site to take measurements and work on materials list. Drove home.
Harvell	7/13/04	312	Drove to Cherry Pt.

	7/14/04		Spent the first 2 hrs. getting on base, getting long-term passes and mtg with Bill Livingston to go over the plan. Then we made a pad for the unit and had it placed by a fork lift. Also set the disconnect and electric meter panel.
	7/15/04		Hung the Connected Energy box and DI panel. Took measurements for conduit, wire, etc. Drove home.
Worley	7/19/04	312	Monday - Drove to Cherry Point.
	7/20/04		Tuesday - Went to site and met with Bill Livingston. Made material list and went to purchase conduit and plumbing. Also, started digging trenches required for electrical, gas, CHP, and communications.
	7/21/04		Wednesday - Continued work on installation. Set gas meter and began running conduit.
	7/22/04		Thursday - completed underground work at site. Ran conduit and wiring for Connected Energy and phone lines. Covered trenches. Mounted critical load panel and moved DI water panel. Performed site cleanup and headed home. Stopped in Lumberton, NC for night.
	7/23/04		Friday - Continued drive home

LOGANEnergy Corp.			
Monthly Site Report			
Period	August-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Worley	8/2/04		System Status: Installing
Worley	8/10/04	312	Tuesday - Drove to Cherry Point.

Worley	8/11/04	312	Wednesday - Met with LP Gas supplier concerning gas tank installation. Also, contacted Carolina Fence and Seegar's Fence concerning fence install. Tied DI panel into house water supply.
Harvell	8/10/04	312	Drove to Cherry Point.
	8/11/04		Went to site briefly to go over some things with Jeff, but had to leave to get to Pax River.
Worley	8/12/04	312	Thursday - Returned to site to continue installation work. Met with fence contractor.
Worley	8/13/04	312	Friday - Travel Home
JW	8/25/04		Spent the day at Cherry Point with Mike and John Kang. We got
			all of the fuel cell conduit run. We will pull wire tomorrow.
			Then it's back to GA Tech to move the fuel cell.
			I plan to spend Wednesday and part of Thursday in NC, and then head back to GA to get GA Tech set on the pad.
MH	8/27/04		Ran 200ft. of conduit up in the 15 ft. ceiling and pulling wires.
Worley	8/23/04	312	Monday - Purchased EMT conduit, couplings, etc.
Worley	8/24/04	312	Tuesday - Drove from Warner Robins to Cherry Point. Purchased #6 wire
Harvell	8/24/04	312	Drove to Cherry Point from Pax River.
Worley	8/25/04	312	Wednesday - Met Mike Harvell and Lt. Kang at site. Ran conduit for critical load panel.
Harvell	8/25/04		Worked on installing 200 ft. run of conduit to CL panel.

Worley	8/26/04	312	Thursday - Returned to site and completed conduit and wiring. Drove back to GA
	8/26/04		Pulled wire from CL and Main panel to fuel cell. Drove home.
	8/31/04		Preparation, then drove to Cherry Point.

LOGANEnergy Corp.			
Monthly Site Report			
Period	September-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Harvell	9/1/04		Found an electrician who can help with terminating wires. Met with him and talked about the job. Ran the DI line from panel to outside wall. Did a little wire pulling, but mostly got rained out.
	9/2/04		Pulled wires from bldg to fuel cell. Ran DI Sol2 wire from DI panel to exterior wall. Hooked up gas and electric meter pulse wires. Cleaned up site.
Worley	9/7/04	312	Tuesday - Left Ft. Gordon around 3:30pm. Arrived in Havelock around 11:00pm.
Worley	9/8/04	312	Wednesday - Went to site and wired up disconnect switch. Terminated all wiring in the fuel cell. Met with the electrician who informed me that the 60amp breaker did not arrive via UPS. Therefore, we could not complete wiring up critical load panel as planned. Told electrician that we would schedule another attempt next week. Also, called fence contractor. Security fence around LPG tanks should be complete by end of week.
Worley	9/13/04	312	Monday - Started drive to Cherry Point. I had to make several stops along the way to locate materials and try to find a conduit bender (1.25 in EMT). I was unable to locate a bender. I spent the night in Florence, SC

Worley	9/14/04	312	Tuesday -Ordered back flow preventer for DI water panel. Also pulled all wired back out of conduit so that I could correct improper bends. Had to pull wire back through conduit one section at a time.
Worley	9/15/04		Wednesday - installed conduit sleeves on all LPG lines at locations where they penetrate the ground. Also, installed conduit 20+ conduit hangers on conduit. Installed back flow preventer and rerouted DI line away from conduit
Worley	9/16/04		Thursday - Met electrcian and G. Worthington to wire up critical load panel.. Began trip home once fuel cell load panel wired.
Worley	9/17/04		Friday - Continued drive home
Worley	9/14/04	312	Tuesday -Finished up last few issued with installation. Finised up DI panel installation. Verified all Cenergy and communications wires in place. Obtained lock and locked LPG security fence. Could not prccede with fuel cell commissioning due to lack of LPG, Internet service, and phone service. Notified base that we could not start the fuel cell until these were installed.
Worley	9/15/04		Wednesday - Returned to site to run conduit and wire up hydronic heater. Installed wall switch for manual control.

LOGANEnergy Corp.			
Monthly Site Report			
Period	October-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Worley	10/18/04	312	Monday - Made drive to Havelock. Stopped in Florence, SC to pick up electrical box to house CHP pump and flowmeter.
Worley	10/19/04	312	Tuesday - Stopped by rental shop to pick up a ladder. Met Mike Harvell at site. Ran PEX tubing and insulation for CHP loop. Also hung hydronic heater near roll up door.

LOGANEnergy Corp.			
Monthly Site Report			
Period	November-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Worley	11/15/04	312	Upgraded heater support system to meet customer preference.
			Took down medium gauge pre-perforated angle and replaced with 1.5 x 0.25 inch steel angle. Installed double locknuts, flat washers, and lock washers on all threaded supports. Re-routed PEX tubing to the new installation. Installed drain/bleed valves near heater to facilitate glycol filling. Ordered flowmeter and RTDs for CHP monitoring. Flowmeter and RTDs staged in fuel cell battery box.
	11/15/04		Upgraded heater support system to meet customer preference.
	11/15/04		Took down medium gauge pre-perforated angle and replaced with 1.5 x 0.25 inch steel angle. Installed double locknuts, flat washers, and lock washers on all threaded supports. Re-routed PEX tubing to the new installation. Installed drain/bleed valves near heater to facilitate glycol filling. Ordered flowmeter and RTDs for CHP monitoring. Flowmeter and RTDs staged in fuel cell battery box.

LOGANEnergy Corp.			
Monthly Site Report			
Period	December-04		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
	12/9/04	312	1102610512,12/9/2004 11:41:52 AM,Running (51)SHUTDOWN, LEVS5_HUMID_LOW_SD, Error Code: (377)(0)
			1102610512,12/9/2004 11:41:52 AM,SD Ref Cool (104)EVENT, SHUTDOWN_EVENT, Error Code: (1001)(0)
	12/11/04		1102806330,12/11/2004 6:05:30 PM,Running (51)ALERT, RECOVER_RADIATOR_FAN, Error Code: (557)(0)
			1102806468,12/11/2004 6:07:48 PM,Running (51)SHUTDOWN, LOSS_RADIATOR_FAN, Error Code: (540)(0)

			1102806469,12/11/2004 6:07:49 PM,SD Ref Cool (104)EVENT, SHUTDOWN_EVENT, Error Code: (1001)(0)
	12/16/04		1103217729,12/16/2004 12:22:09 PM,ESTOP (107)ESTOP, HW_ESTOP_SARC_L0, Error Code: (534)(0)
			1103217733,12/16/2004 12:22:13 PM,ESTOP (107)SHUTDOWN, LOSS_ATO_BLOWER, Error Code: (546)(0)
			1103217997,12/16/2004 12:26:37 PM,SD Ref Cool (104)SHUTDOWN, LOSS_ATO_BLOWER, Error Code: (546)(0)
			1103218011,12/16/2004 12:26:51 PM,ESTOP (107)ESTOP, HW_ESTOP_SARC_L0, Error Code: (534)(0)
			1103218021,12/16/2004 12:27:01 PM,ESTOP (107)ESTOP, HW_ESTOP_SARC_L0, Error Code: (534)(0)
			1103218223,12/16/2004 12:30:23 PM,ESTOP (107)ESTOP, HW_ESTOP_SARC_L0, Error Code: (534)(0)
			1103218229,12/16/2004 12:30:29 PM,ESTOP (107)SHUTDOWN, LOSS_ATO_BLOWER, Error Code: (546)(0)
			1103218709,12/16/2004 12:38:29 PM,Manual (20)ESTOP, HW_ESTOP_FS7_PRES2_FS9_L3, Error Code: (629)(0)
			1103218739,12/16/2004 12:38:59 PM,Manual (20)ESTOP, HW_ESTOP_FS7_PRES2_FS9_L3, Error Code: (629)(0)
			1103219682,12/16/2004 12:54:42 PM,Manual (20)ALERT, RECOVER_RADIATOR_FAN, Error Code: (557)(0)
			1103219792,12/16/2004 12:56:32 PM,Manual (20)SHUTDOWN, LOSS_RADIATOR_FAN, Error Code: (540)(0)
	12/3/04		Fixed leak on gas line. Found that radiator fan was making a strange noise, installed temporary vibration damper. Started fuel cell. Ordered dial-up modem for connected energy box and installed. Filled glycol loop. Found that floor drain used for DI waste water was clogged. Rerouted waste water through wall to outside of building. Also, the fuel cell modem is not operational and the radiator fan or controller will have to be replaced. We will also need to get an additional phone line since we eill be using dial-up for the Connected Energy monitoring. There is also a small leak at the hydronic heater that will have to be repaired during the next site visit.

	12/8/04		Radiator fan inoperable. Fuel cell modem malfunctions. Both components bad from mfg.
			Replace radiator fan and SARC board. I also installed v1.31 software. The leak at hydronic heater has been repaired. The CHP pump is extremely undersized. There is less than 0.5gpm through the loop.
	12/16/04		CHP pump too small and radiator MCB bad.
			Replaced MCB5 - radiator fan. Installed Bell & Gossett PL-55 circulation pump. Refilled glycol loop and restarted fuel cell. Fuel cell restarted at 3:40pm on Thursday, December 16, 2004. Assuming thet the system runs, this could be used as a commissioning date. All that remains to be done at the site is reconfigure the Connected Energy to work with the new phone line. The CHP loop should also be checked for leaks.

LOGANEnergy Corp.			
Monthly Site Report			
Period	1/1/05 – 6/2/05		
Site	Cherry Point		
Engineer	**Date**	**PP S/N**	**Activity**
Worley	1/5/05		ZyXel modem not functioning

			1/4/2005 Called Jesse Perkins to try and reconfigure modem. Could not get into configuration mode. Ordered a new modem next day delivery. Shutdown fuel cell briefly to activate modbus communications with Connected Energy. Fuel cell only down for a few minutes. Restarted fuel cell. 1/5/2005 Received new modem and installed. Connected Energy verified that they could communicate with the system. Initial Metrics: CHP flow rate approximately 2.5 gpm, building ambient temp 75F, discharge of hydronic heater 85F Gas meter reads as follows 0 x 1,000,000; 0 x 100,000; 7 x 10,000; 6 x 1,000 = 76,000

Harvell	4/8/05		Radiator fan failure caused the shutdown. Installed v 1.32 S/W. Installed radiator fan set point. Installed new polisher retrofit. Installed desulfurizer. Restarted with no issues.
Harvell	6/2/05		Modified wastewater drain. It was causing problems at the base. Wastewater from DI panel was draining across a driveway and causing an "algae slick". It was a hazard for those working at night. Re-routed the wastewater line by extending it about 20 ft. to a stormwater drain.